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ORIGINAL RESEARCH

An Observational Study to See the Effect of Intravenous Dexmedetomidine Infusion on the Duration of Subarachnoid Block with Isobaric Ropivacaine in a Tertiary Care Hospital in Raichur

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ABSTRACT

Background: Choice of anaesthesia for surgery below the umbilicus is Subarachnoid block with Bupivacaine traditionally. Dexmedetomidine is being used with Ropivacaine to avoid side effects of Bupivacaine. The objective of this study is to compare the groups (group 1- only Ropivacaine and group 2- Ropivacaine with Dexmedetomidine) with respect to duration of sensory block and motor block, sedation, and complications.

Material and Methods: This is a prospective observational study and 30 patients in each group were included. Duration of sensory block and motor block, scale of sedation and complications were looked for. Patients with bradycardia, AV block, using beta blockers, calcium channel blockers or anti-arrhythmic and hepatic or renal dysfunction were excluded. Mean and standard deviation for continuous variables, frequencies and percentages for categorial variables were determined. Chi-Square test, Paired T test, Independent T test or Unpaired Test, and Wilcoxon Sum Rank Test were done.

Results: Mean age and weight of the group-1 were 38.80±4.2years and 62.23±5.43 kg and that of group-2 were 39.67±5.9 years and 63.45±6.23 kg respectively. Mean duration of sensory and motor blockade of the group-1 were 189±18.2 minutes and 158±18.77 minutes respectively and that of group-2 were 230±19.7 minutes and 189±21.34 minutes respectively (p<0.001). Ramsay sedation scores in the group with only Ropivacaine was 1.7 ± 0.3 while in Dexmedetomidine group was 2.4±0.3 (p<0.001). 13 patients experienced hypotension, 5 were from only Ropivacaine group and 8 were from Dexmedetomidine group(p<0.001). 12 patients experienced bradycardia among which 4 were from only Ropivacaine group and 8 from Dexmedetomidine group(p<0.001).

Conclusion: Intravenous dexmedetomidine in patients getting 0.75% isobaric ropivacaine for subarachnoid block, increases time to two dermatomal regression of sensory blockade, duration of sensory block, duration of motor block and provides good sedation.

Keywords: Dexmedetomidine, subarachnoid block, isobaric ropivacaine, sensory block, motor block.

INTRODUCTION

Regional anaesthesia has come to occupy an important part in clinical anaesthesiology. As with other fields, regional anaesthesia too, has undergone major developments, both in techniques and drug availability.[1]Traditionally, bupivacaine has emerged as the most used

drug for spinal anaesthesia. However, since it has undesirable effects such as hypotension, bradycardia, prolonged duration of motor paralysis, cardiotoxicity and central nervous system toxicity.[2,3] Ropivacaine thus was developed after bupivacaine was noted to be associated with significant number of cardiac arrests. Cardiotoxicity of ropivacaine is less than bupivacaine as ropivacaine causes lesser depression of cardiac contractility.[4]

Isobaric Ropivacaine is regularly used in regional anaesthesia for subarachnoid block, epidural anaesthesia and analgesia. It is less potent when used in low doses such as for epidural analgesia or spinal anesthesia in comparison with bupivacaine.[5]Intrathecal ropivacaine 12 mg is approximately equivalent to bupivacaine 8 mg.[6]For prolongation of anaesthesia different adjuvants like opioids, adrenergic, GABA agonists, NMDA antagonists, have been used.[7,8]

Intravenous alpha 2 adrenergic agonists are being increasingly used as they provide sedation and analgesia without causing respiratory depression.[9] Dexmedetomidine is a highly selective α2 adrenergic agonist which was FDA approved in 1999 and used in India since 2012 and has been used for premedication and as an adjunct to general anaesthesia. It reduces opioid and inhalational anaesthetic requirements.[10] In addition, because it affects locus coeruleus area which is associated with modulation of sleep and respiration, it has sedative effect with minimal respiratory depression.[11] Previous studies have shown significant prolongation of duration of sensory and motor blockade with intrathecal administration of alpha 2 adrenergic agonists with local anaesthetics and hence synergistic interaction between two.[9,12] IV dexmedetomidine can also prolong the duration of sensory block, motor block, and time to first analgesic request associated with spinal anesthesia.[13]

Various studies have been performed comparing intravenous dexmedetomidine and spinal anesthesia with bupivacaine.[14,15] Studies have been done in past about use of ropivacaine intrathecally for spinal anaesthesia. Wahedi W et al in 1996 performed the first dose finding study of Ropivacaine for spinal anesthesia in a randomized, double-blind study.[16] They concluded that at concentrations of 0.5% and 0.75%, ropivacaine results in long-lasting spinal anaesthesia. McNamee D.A et al in 2002 compared the efficacy and safety of plain ropivacaine with plain bupivacaine for spinal anaesthesia in patients undergoing total hip arthroplasty.[17] They found that onset of motor and sensory block was rapid with no significant differences between the two groups. However, there is limited literature regarding effects of intravenous alpha 2 agonist on duration of spinal anaesthesia with 0.75% isobaric ropivacaine. In this prospective observational study, we intend to observe the effects of intravenous dexmedetomidine infusion on duration of subarachnoid block with 0.75% isobaric ropivacaine in patients undergoing infraumbilical surgeries with respect to duration of sensory block, duration of motor block, scale of sedation, occurrence of bradycardia and hypotension.

This observational study aimed to compare the 2 groups with respect to Duration of sensory block and motor block, scale of sedation, bradycardia and hypotension and other complications, if any.

MATERIALS & METHODS

It is a Prospective observational longitudinal study conducted in various operation theatres of tertiary health care center. The study was conducted for a period of two months. Based on previous studies we found a prolongation of duration of sensory blockade by 15 mins with intravenous dexmedetomidine administration. Approximately 28 patients needed to be observed in each group with alpha error of 95% and beta error of 80%. Assuming a dropout rate of 10% we decided to study 30 patients in each group.

Patients administered subarachnoid block with 0.75% isobaric ropivacaine as per routine theatre protocol were observed as follows

- A thorough history and clinical examination, confirmation of consent, starvation and fitness.
- Attachment of monitors, pulse oximetry, ECG monitor, non-invasive systolic and diastolic blood pressure and SpO2 after patient is on table and intravenous access secured with appropriate gauge cannula, and coloading with appropriate intravenous fluid.
- Patient placed in sitting or lateral position, and SAB were established at L3-L4 interspace by standard midline approach with 3 to 3.5 ml of 0.75% isobaric ropivacaine using 25G Quincke's needle. Then patient was turned supine and received appropriate oxygen supplementation. Time of SAB was noted as zero time. Onset of sensory blockade and highest level of sensory blockade reached were noted by using loss of pin prick sensation.
- Onset and highest level of motor blockade reached were noted by Modified Bromage Scale (MBS). As per routine OT protocol, anxious patients receiving dexmedetomidine infusion at rate of 0.2 to 0.7mg/kg/hr or injection midazolam 0.02mg/kg for sedation and other patients receiving no sedation. All patients were given SAB using above protocol who have received either dexmedetomidine infusion or midazolam/ no sedation were observed. Following parameters were noted.
- Onset, level and duration of sensory block were noted. Sensory blockade was checked by using pinprick technique at 1,2,5 min after giving spinal anaesthesia, and then at every 5 min till 30 min and then at every 30 min till recovery of block to S1 level. Recovery time for sensory blockade were defined as two dermatome regressions of anaesthesia from the maximum level. Onset and motor block duration were noted by using Modified Bromage Scale1, Motor block duration was time between MBS -2 to return of muscle power till MBS-5 [MBS 1=complete block i.e. unable to move feet or legs, 2=almost complete block i.e. able to move feet only, 3=partial block i.e. just able to move knees, 4=detectable weakness of hip flexion while supine i.e. full flexion of knees, 5=no detectable weakness of hip flexion while supine i.e. full flexion, 6=able to perform partial knee bend], Motor blockade was assessed by using MBS at 1,2,5 min after giving spinal anaesthesia, and then at every 5 min till 30 min and then every 30 min till full recovery of motor level by asking the patient to move and flex legs with prior information to operating surgeon during intraoperative period. Dose and duration of dexmedetomidine infusion were noted. Any reason for termination of dexmedetomidine infusion was noted.
- Level of sedation was assessed according to Ramsay Sedation Scale (RSS) 2 [1= Patient anxious, agitated or restless, 2= Patient cooperative, oriented, and tranquil alert, 3= Patient responds to commands, 4=Asleep, but with brisk response to light glabellar tap or loud auditory stimulus, 5=Asleep, sluggish response to light glabellar tap or loud auditory stimulus, 6=Asleep, no response]. Sedation scale was evaluated at 1,2,5 min after giving spinal anaesthesia, then at every 5 min till 30 min and then every 30 min till complete recovery of sensory and motor blockade.
- Number of episodes of hypotension requiring treatment with injection ephedrine were noted. Hypotension defined as systolic blood pressure of less than 90 mmHg or decrease of 30% from the baseline. Number of episodes of bradycardia requiring treatment with injection atropine were noted. Bradycardia defined as heart rate less than 50 beats/min. Other complications if any were recorded.

Inclusion criteria:

All adult patients of either sex between 18 years to 65 years and willing to consent for the study, receiving intrathecal 0.75% isobaric ropivacaine for infraumbilical surgeries and receiving dexmedetomidine infusion for sedation and not receiving any other sedation with ASA physical status I and II

Exclusion criteria:
Patients with pre-existing bradycardia, AV block,using beta blockers, calcium channel blockers or any other anti-arrhythmic drugs, hepatic or renal dysfunction and history of allergy to amide anaesthetics agents.

Statistical analysis:
We recorded the data with respect to patients who did not receive intravenous dexmedetomidine and those who received intravenous dexmedetomidine out of all patients who received intrathecal 0.75 % isobaric ropivacaine for SAB. Data was entered into Microsoft Excel and analysis was done using the statistical Package for Sciences (SPSS version 20.0 trial version). Descriptive statistics such as mean and standard deviation(SD) for continuous variables, frequencies and percentages for categorial variables were determined. Association between variables were analysed by Chi-Square test, Paired T test, Independent T test or Unpaired Test, and Wilcoxon Sum Rank Test. Level of significance was set at 0.05.

RESULTS
A total of 60 patients were included in the study who were posted for surgeries under spinal anaesthesia with 0.75% isobaric ropivacaine with or without intravenous dexmedetomidine infusion, with respect to two dermatomal regression of sensory blockade, duration of sensory block, duration of motor block, Ramsay Sedation Score, number of episodes of hypotension which required treatment with inj. Ephedrine and number of episodes of bradycardia requiring treatment with inj. Atropine and other complications if any.
Mean age and weight of the group receiving isobaric ropivacaine were 38.80 ± 4.2years and 62.23 ± 5.43 kg and that of ropivacaine with Dexmedetomidine were 39.67 ± 5.9years and 63.45 ± 6.23 kg respectively. There were 10 females and 20 males included in the ropivacaine group and 11 female and 19 males in the Dexmedetomidine group respectively and the difference between the two groups was not statistically significant.

Table 1:Distribution of patients according to type of surgery performed

Surgery	Isobaric Ropivacaine		Isobaric Ropivacaine with Intravenous Dexmedetomidine	
	Frequency	Percentage	Frequency	Percentage
General surgery	13	43.33	14	46.66
Orthopedics	6	20.00	7	23.33
Urology	7	23.33	8	26.67
Plastic surgery	4	13.33	1	03.33
Total	30	100.00	30	100.00

Patients undergoing different surgeries from various departments were included according to [Table 1].
Mean duration of sensory blockade and motor of the group receiving Isobaric Ropivacaine were 189 ± 18.2 minutes and 158 ± 18.77 minutes respectively and that of the group with Dexmedetomidine were 230 ± 19.7 minutes and 189 ± 21.34minutes respectively and the difference was statistically significant ($p<0.001$). Ramsay sedation scores in the group with only Ropivacaine was 1.7 ± 0.3 while in Dexmedetomidine group was 2.4 ± 0.3 and the difference between both the groups was statistically significant ($p<0.001$). In the present study we witnessed a total of 13 patients undergo hypotension out of which 5 were from only Ropivacaine group and 8 were from Dexmedetomidine group and this difference was statistically significant ($p<0.001$). There was a total of 12 patients who experienced

bradycardia among which 4 were from only Ropivacaine group and 8 from Dexmedetomidine group and the difference was statistically significant ($p<0.001$).
In the present study, we estimated correlation between different dose ranges of Dexmedetomidine and duration SAB and the results were as in [Table 2].

Table 2:Correlation between different range of iv dexmedetomidine doses and duration of sab (isobaric ropivacaine with iv Dexmedetomidine group)

Range of doses of Dexmedetomidine	No. of patients	Mean duration for two dermatome regressions of sensory blockade	Mean duration of sensory block	Mean duration of motor block
15 - 25	5	114	213	182
25.5 - 35	16	114	223	204
35.5 - 45	9	108	253	224

Table 3: Correlation between different ranges of iv dexmedetomidine doses and no. of episodes of hypotension and bradycardia (isobaric Ropivacaine with iv dexmedetomidine group)

Range of doses of Dexmedetomidine	No. of patients	No. of episodes of hypotension	No. of episodes of bradycardia
15 - 25	5	-	-
25.5 - 35	16	4	3
35.5 - 45	9	3	3

Other complications like respiratory depression, desaturation and arrhythmias were not seen in either group.

DISCUSSION

Choice of anaesthesia for surgery below the umbilicus is Subarachnoid block. Due to ease of administration, fast onset, effective sensory and motor blockade with spared spontaneous respiration, low cost, safety in patients with full stomach, absolute relaxation of abdominal musculature, exclusion of the need for intubation and earlier return of intestinal activity. SAB is a choice of anaesthesia in pelvic surgeries and lower limb surgeries. Till recently Bupivacaine 0.5% heavy was the only drug used for spinal anaesthesia after the discontinuation of lidocaine's intrathecal use. In 2009 ropivacaine another aminoamide local anaesthetic having all the advantages but less the cardio and CNS toxicity of bupivacaine was introduced in India.[18,19]

In our study, time for two dermatomal regressions of sensory blockade in dexmedetomidine group was significantly greater than that in non-dexmedetomidine group. Similar results were found in various studies conducted by Harsoor S et al,[15] in 2013 Chilkunda N20, Rekha Kumari et al,[21] in 2017, Hong JY et al,[14] in 2012 Kaya FN et al,[12] in 2010. Duration of sensory blockade in dexmedetomidine group was significantly greater than that of non-dexmedetomidine group. Similar findings were reported in various studies by Balvinder Kaur Rekhi et al,[18] in 2017, Upadhyay R Kavya et al,[22] in 2018 Chilkunda N. Dinesh et al,[20] in 2014, Kumkum Gupta et al,[23] in 2014, Rekha Kumari et al,[21] in 2017. This result of intravenous dexmedetomidine on the sensory blockade can be explained by increased activation of α2C and α2A receptor in the dorsal horn at the spinal cord directly suppressing pain transmission by reducing the release of pronociceptive transmitters, substance P and glutamate, and hyperpolarization of interneurons resulting in inhibition of nociceptive

impulse transmission. Duration of motor block was significantly prolonged in dexmedetomidine group compared to non-dexmedetomidine group. Similar findings were reported in various studies by Balvinder Kaur Rekhi et al,[18] Upadhyay R Kavya et al,[22] Chilkunda N. Dinesh et al,[20] Rekha Kumari et al,[21] Kaya FN et al,[12] Kumkum Gupta et al.[23] The hyperpolarization of spinal neurons may describe the extension of motor blockade. Intrathecal dexmedetomidine has been identified to affect dose dependent increase in duration of motor block.[7] On evaluation of the various studies it was noticed that in the studies where prolongation of motor blockade was seen,[12,20,21,22,23] the dose of dexmedetomidine was higher. In the present study, Ramsay sedation score (RSS) in dexmedetomidine group was more than non-dexmedetomidine group 1. Similar findings were reported in studies by Balvinder Kaur Rekhi et al,[18] Elcicek K et al,[24] Hong JY et al,[14] Chilkunda N. Dinesh et al.[20] Dexmedetomidine produces a reduction in action of the projections of the locus coeruleus to the ventrolateral preoptic nucleus. The sedative effect of dexmedetomidine acts through the endogenous sleep-promoting pathways, thus generating natural sleep patterns.

The low incidence of hypotension was attributed to provision of sufficient preoperative hydration to the patients. Previous Studies by Balvinder Kaur Rekhi et al,[18] Rekha Kumari et al,[21] Harsoor S. et al,[15] and Jia Song et al,[6] in 2013, showed overall increased incidence of hypotension in patients receiving intravenous dexmedetomidine. The decrease in blood pressure and episodes of hypotension may be related to decreased central sympathetic outflow. Number of episodes of bradycardia requiring treatment with injection atropine were more in dexmedetomidine group compared to non-dexmedetomidine group as in similar studies by Balvinder Kaur Rekhi et al,[18] Chilkunda N. Dinesh et al,[20] Rekha Kumari et al.[21] Dexmedetomidine is known to cause dose dependent bradycardia due to reduction in central sympathetic outflow6. In dexmedetomidine group we found that 8 patients who received dexmedetomidine in higher doses like 35.5-45 mcg had graeter mean two dermatomal regression time, mean duration of sensory blockade and mean duration of motor block than the patients who received lesser dose of dexmedetomidine. The sample size of patients with increased duration of sensory and motor block was too small for statistical correlation. However, our observations suggest that higher doses of IV dexmedetomidine increased the duration of sensory and motor block. Similar findings were reported by Upadhyay R Kavya et al in 2018.[22] Complications such as desaturation, respiratory depression, arrhythmias, vomiting, shivering were not observed in any of our patients.

LIMITATIONS OF THE STUDY

It was an observational study of relatively small sample size. The dose dependent increase in the duration of sensory block, duration of motor block and number of episodes of hypotension and bradycardia need a larger sample size for statistical correlation. Better results may be achieved with randomized, controlled trial relating larger number of patients.

CONCLUSION

We conclude that intravenous dexmedetomidine in patients getting 0.75% isobaric ropivacaine for subarachnoid block, increases time to two dermatomal regression of sensory blockade, duration of sensory block, duration of motor block and provides good sedation during the surgery. There was dose dependent increase in the duration of sensory block, duration of motor block and number of episodes of hypotension and bradycardia.

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